CHAPTER 1
INTRODUCTION

South Asia, with its rich Palaeolithic remains, occupies an important place in human evolutionary studies. However, the region attracts little attention in global discussions on human biological and cultural evolution due to the lack of a firm chronological framework, high-resolution lithic analysis, and reliable palaeoenvironmental reconstructions. This study aims to establish a credible chronological framework as well as the environmental context of Palaeolithic cultural development in the Gundlakamma and adjoining river basins of the Prakasam District, Andhra Pradesh. Previous sporadic studies from the mid 1860's onwards have highlighted the region's archaeological potential by identifying rich Palaeolithic remains, animal fossils, and their unique geological associations (e.g., Youngest Toba Tuff deposits, inland sand dunes). The current research uses multidisciplinary methods that include excavations, chronometric age estimations (Luminescence and U series), high-resolution lithic technology studies, and geoarchaeology to examine the region's extensive prehistoric remains.

The region of South Asia is geographically pivotal in understanding hominin behavioural evolution, adaptations and dispersals. The region is presumed to be situated in the modern human dispersal route and connects the complex lithic technologies to the west (Africa and western Eurasia) and simple lithic technologies to the east (East Asia). Research on the Palaeolithic cultures in the region can be traced back to the mid-19th Century ((Foote, 1866), which is almost contemporary to early studies in the rest of the Old World (Daniel, 1962). Since then, abundant research has been carried out to understand the hominin cultural developments in the region (Dennell, 2008; Kennedy, 2000; Sankalia, 1974). Despite the rich material evidence and long history of research, the region was given little importance in the global discussions of hominin behavioural evolution and dispersals. However, recent research on the Palaeolithic record of South Asia (for instance, Akhilesh et al., 2018; Haslam et al., 2012; Mishra et al., 2013; Petraglia et al., 2007) has contributed much towards understanding hominin evolution and possible routes of migrations into the region. Petraglia et al. (2007) pushed back the date of South Asia's initial modern human colonisation to have occurred between 75 ka and 120 ka, which was previously held to be later than 60 ka (Mellars, 2006).

Similarly, the excavations at Methakheri have pushed back the antiquity of microlithic industries in the region to 48 ka (Mishra et al., 2013), which was previously held to be not older than 36-28 ka (Deraniyagala, 1992). In addition, the Middle Palaeolithic tools from

Attirampakkam dated to 380 ka (Akhilesh et al., 2018) have extended support to theories suggesting the South Asian Middle Palaeolithic have evolved from preceding lithic technologies locally. While earlier studies have highlighted significant issues in the prehistoric record of the region, it is seen that the Palaeolithic record of the region (spanning from 400 to 10 ka) comprises diverse lithic technologies, which chronologically overlap one another (Fig. 1). These recent multidisciplinary studies have highlighted the significance of the Prehistoric record of South Asia and emphasised the complexity and diversity of the region's archaeological record. Besides, these studies have called for a re-evaluation of earlier concepts and trends in research in South Asian Prehistoric studies. A few of such concepts, associated issues & debates, which include issues concerning Late Acheulian to Middle Palaeolithic transitions, Youngest Toba Tuff deposits in South Asia as a Late Pleistocene chronological marker, and initial Modern Human colonisation of South Asia, and the nature of Post Middle Palaeolithic cultural developments. The debates and status of the abovementioned issues are dealt with in sections 1.1 to 1.4.

To better appreciate these issues, the origin and antiquity of Palaeolithic technologies in South Asia must be comprehended. Securely dated Palaeolithic sites between 400 to 40 ka and detailed typo-technological analyses of lithic assemblages are prerequisites to understanding the abovementioned issues. The current work addresses the aforementioned issues by approaching potential Palaeolithic sites with multidisciplinary methods. Generating chronometric ages for the Palaeolithic assemblage will fill significant gaps in our understanding of the cultural evolution of the region. High-resolution typo-technological analyses of lithic assemblages can help in understanding the similarities and differences among the assemblages. The Gundlakamma, the Paleru and the Manneru river basins were chosen for investigations due to their rich prehistoric record (Issac, 1960; Kumari, 1987; Rao, 1979; Srinivasulu, 2012). In addition, recent surveys by geologists from the Geological Survey of India have identified volcanic ash beds and animal fossils along the Gundlakamma River (Reddy & Shah, 2004). The study area is between 15º to 16º north latitudes and 79º to 80º east longitudes, occupying an area of 10,000 sq. km. The study area is drained by four rivers, namely the Gundlakamma, the Paleru, the Musi and the Manneru, which forms a fan-shaped basin between the major east-flowing rivers, the Krishna in the north and the Pennar in the South. These rivers originate in the Nallamalai ridge, which forms the western flank of the study area. On the east, it is bounded by the Bay of Bengal. The whole basin politically comes under the Prakasam District of Andhra Pradesh.

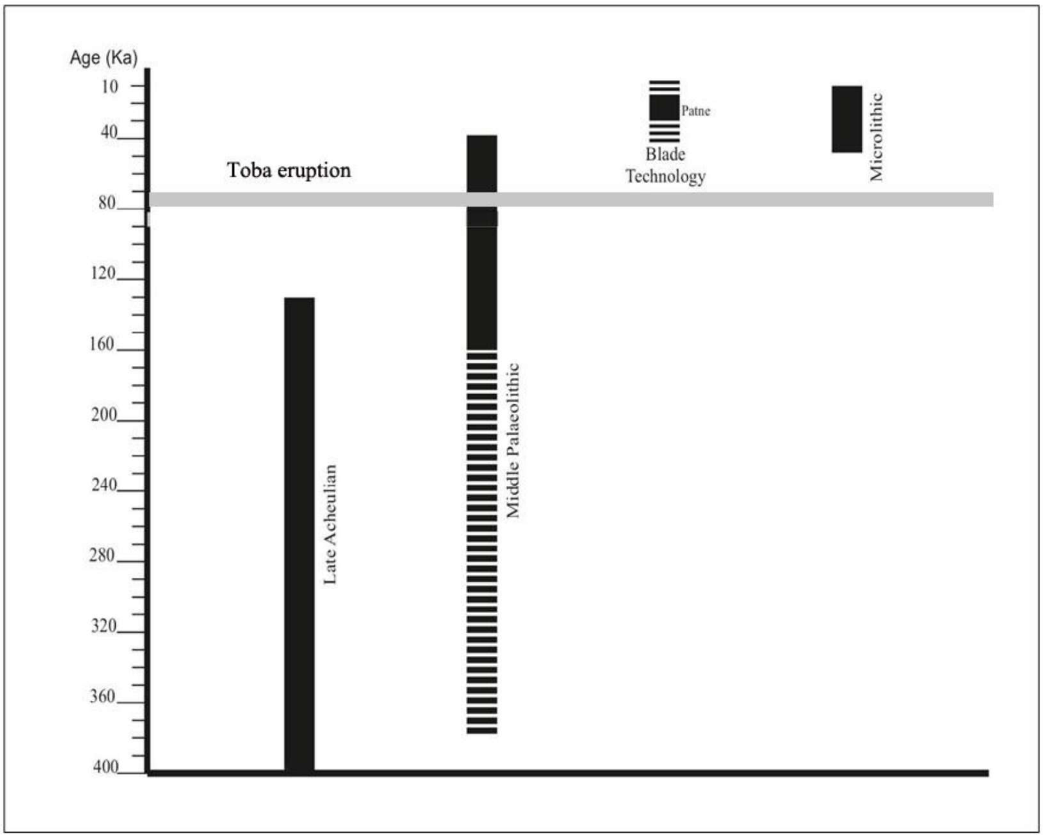

Figure. 1: Palaeolithic record of South Asia from 400 – 10 ka (Adopted from Anil et al., 2018).

1.1 Late Acheulian-Middle Palaeolithic Transitions in South Asia

During the second half of the Middle Pleistocene, the transitions between Lower Palaeolithic bifacial technologies and subsequent Middle Palaeolithic prepared core technologies are seen as an important landmark in hominin behavioural evolution. These technological transitions are believed to have triggered significant changes in the cognitive capabilities of the hominin populations (Foley & Lahr, 1997). The roots of these transitions are debated between single-origin and spread through dispersals (Foley & Lahr, 1997; Lahr & Foley, 2005, 1998) vs *in situ* developments in Africa (Clark, 1977; Herries, 2011; Porat et al., 2010; Tryon & Faith, 2013), in Europe (White & Ashton, 2003) and South Asia (Petraglia et al., 2003). However, recent evidence suggests that some of these transitions are due to behavioural change rather than biological change or dispersals. These studies have pointed out that these transitions occurred in Africa, Europe, and South Asia almost simultaneously (~ 400 ka) but are associated with different hominin species (in Africa – Modern Humans; in Europe- Neanderthals/*H. heidelbergensis*; and in South Asia – an unknown hominin species) (Akhilesh et al., 2018; Deino et al., 2018; Mcbrearty & Brooks, 2000; Richter et al., 2017). Therefore, understanding these transitions is significant to obtain insights into hominin behavioural evolution and cognitive changes.

South Asia shows rich evidence of hominin occupation starting from at least 1.5 ma (Pappu et al., 2011). Evidence belonging to all three major phases of the Palaeolithic period is reported from the region. Continuous archaeological sequences from Lower Palaeolithic to Mesolithic are reported from several sites and river valleys (e.g., Attirampakkam, 16R Dune, Bhimbetka, Son valley, Hunsgi-Baichbal valley, Paleru valley, Manneru valley). Bifaces are characteristic tools of the Acheulian, whereas flake implements (e.g., scrapers, points) dominate the Middle Palaeolithic. Several Acheulian sites incorporate evidence of prepared core technology; similarly, bifaces continue into Middle Palaeolithic in South Asia (James & Petraglia, 2009). Besides, a few regions yielded evidence of transitions from Late Acheulian to Middle Palaeolithic, such as the Renigunta region in Andhra Pradesh (Murty, 1966), the Kaladgi and Hunsgi basins in Karnataka (Paddayya, 1982; Petraglia et al., 2003), the Orsang valley in Gujarat (Ajithprasad, 2005). The rich Palaeolithic record in South Asia thus offers immense potential to understand the Lower to Middle Palaeolithic transitions. However, evidence for such transitions is mainly inferred from surface collections, with very few excavated sites. Further, a lack of secure chronometric ages and hominin fossil remains from the South Asian Palaeolithic record hinder our understanding of the nature of these transitions.

1.2 Youngest Toba Tuff (YTT) beds in South Asia as a Late Pleistocene chronological marker?

The 74 ka Toba super-eruption and its effects on global climate and hominin behaviour have been one of the most discussed topics in the Palaeo-anthropological and archaeological research in the last four decades (Appenzeller, 2012; Balter, 2010; Williams, 2012a, 2012b). South Asia situated geographically close to the Toba volcano also have been the centre of aforesaid discussions. It was estimated that after the eruption, the region of South Asia was buried under a 5 cm thin sheet of ash. Several river valleys in peninsular India still contain these ash deposits in the alluvial stratigraphy, with thicknesses varying from 10 cm to 5 m (Acharyya & Basu, 1993). Williams discovered the first terrestrial occurrences of Toba ash during archaeological fieldwork led by J. Desmond Clark and Virendra Misra in 1980-81 (Williams & Royce, 1982). In Maharashtra, Western India, Acheulean artefacts occur in fluvial channels cut into or overlain by volcanic ash. The ash was dated by multiple (rather than single crystal) radiogenic argon to the Middle and Lower Pleistocene (Mishra, 1995) and correlated with the Middle and Older Toba Tuffs. However, they are geochemically matched to the YTT and all other analysed ash outcrops (Westgate et al., 1998). No in-situ primary archaeological sites were reported associated with ash deposits from Maharashtra. Petraglia et al. (2007) reported archaeological horizons at Jwalapuram, Jurreru Valley, Kurnool, above and below the YTT. In South Gujarat, at Tejpur on the Madhumati River, YTT is stratified within a 36 m thick sequence of fluvial sands and gravels (Raj, 2008).

Further afield, Toba ash is reported in two sedimentary cores from Lake Malawi, providing an isochron for correlating SE African sedimentary archives to global climatic records (Lane et al., 2013b). On the southern Cape coast of South Africa, the YTT occurs as an ultra-crypto tephra at Pinnacle Point PP5-6, near the base of wind-blown sand (E. I. Smith et al., 2018b), directly beneath the oldest dated occurrence of the Howiesons Poort MSA industry with backed blades (Brown et al., 2012). YTT shards were also identified 9 km from PP5-6 in an open site with MSA artefacts (Smith et al., 2017). Remarkably, South African archaeological sites have more secure associations with Toba ash than any Indian site. The South African evidence indicates the most recent estimates of Toba's eruptive volume (including the Malawi data) of ~3800 km^3 dense-rock-equivalent and aerial coverage of ~40 million km^2 (Costa et al., 2014) are likely too low. Although this is the largest known explosive eruption of the Quaternary and possibly the last 26 million years, no consensus has been achieved regarding the global or local environmental impacts of this stupendous eruption (Lane et al., 2013; Williams, 2012b). Carbon isotopes from palaeosol carbonate from three sites spanning >400 km in the Narmada and Son Valleys show that the YTT blanketed a C3 forested landscape (lowδ13C) and that grasslands predominated after the eruption (Williams et al., 2009). Jwalapuram Locality 3 has a 7.5 m section with 2.4 m of reworked YTT (Haslam et al., 2010). Carbonate nodule isotopic analysis shows that the environment remained from grassy woodlands to wooded grasslands throughout, with slightly higher average δ13C and δ18O values within the YTT than above or below. Blinkhorn et al. (2012) analysed carbonates from 10 cm below (but not within or above) the YTT at 12 sites in the Jurreru Valley and found high inter-site variation in δ13C and δ18O, reflecting a mosaic of dry/mesic habitats ranging from woodlands to more open grasslands. Phytolith estimates of grass cover were generally higher but clearly co-vary with carbon isotope data (Blinkhorn et al., 2012).

Currently, absolute ages in the context of YTT beds are available from Jwalapuram, the middle Son valley, Tejpur (Gujarat), Bori, Morgaon and the Sagileru valley (Biswas et al., 2013;

Geethanjali et al., 2019; Neudorf, 2012; Petraglia et al., 2012; Singh et al., 2022). These chronometric ages suggest that all the YTT beds in South Asia are not primary deposits; most are found in redeposited context. Tejpur in Gujarat is the only site in South Asia that yielded the closest age bracket for YTT deposits ranging from 74±7 to 60±6ka (Biswas et al., 2013). Below YTT sediments from Jwalapuram 22 and Jwalapuram 3 were dated 85 ka and 77 ka; however, the above-ash-sediments are found to be later than 35 ka and 55 ka, respectively. These studies suggested the need to independently assess the deposition of YTT through other chronometric ages before using it as an isochron.

1.3 Initial Modern Human Colonization of South Asia

Although modern humans emerged in Africa and subsequently migrated to other parts of the world, the timing of such events, the routes taken, and associated lithic technologies are poorly understood. The absence of fossil records from the key regions in the dispersal route (such as South Asia) and diverse lithic technologies associated with modern humans in some regions (such as Southeast Asia, Australia, and China) prevents us from generalising the nature of these dispersals. The timing and the nature of the initial modern human presence in South Asia have created debates in the light of recent archaeological and genetic research (Appenzeller, 2012). The currently debated two conflicting models for South Asia's earliest modern human colonisation (Groucutt et al., 2015b; Mellars et al., 2013b) rest on a slender foundation of archaeological evidence and the absence of human fossils. The first model states that modern humans arrived ~50–60 ka from Eastern Africa along the coastlines of Southern and Southeast Asia to reach Australia by ~45–50 ka. The second proposes the dispersal of modern humans from Africa as early as 120–130 ka (Groucutt et al., 2015b), reaching southern Asia via the Levant or the south Arabian Peninsula, and well before the Toba "super-eruption" at 74 ka. The Post-Toba model is based on molecular genetics dating, combined with similarities between Indian Late Palaeolithic/Upper Palaeolithic assemblages and Howiesons-Poort-like ones in South and East Africa. Arguments advanced in support of the latter model rest on the evidence unearthed from Jwalapuram wherein a series of stone tool assemblages have been recovered from locations both underlying and overlying thick deposits of Toba ash-fall, with a series of associated OSL dates ranging from ~77 to ~38 ka (Petraglia et al., 2007).

However, both the models mentioned above have certain drawbacks. DNA analysis often assumes that modern sampled populations accurately reflect all past populations, which ignores or rarely considers demographic changes (Petraglia et al., 2010). On archaeological grounds, both models are problematic. The Pre-Toba colonisation model suggests that the Indian microlithic technology was an in-situ development from local post-Toba Middle Palaeolithic technologies, but technologically transitional industries between 70 and 45 ka are absent. The earliest Indian microlithic technologies are similar to those documented over large parts of the Old World. The Post-Toba model fails to explain the gaps between the genetically estimated age of South Asia's initial modern human colonisation (50-60 ka) and the earliest directly dated occurrences of typical microlithic industries in South Asia (35 to 45 ka). Australia's human occupation by at least 50 ka also suggests that earlier sites shall be found in South Asia along the route to Australia.

1.4 Post-Middle Palaeolithic Cultural developments in South Asia

More than 150 years of Prehistoric research in South Asia has produced vast amounts of material records belonging to Palaeolithic and Mesolithic cultures and offers immense scope to understand the hominin behavioural evolution. However, due to a lack of robust chronologies and well-studied lithic assemblages, the region was given little attention in human evolutionary studies. The issues and debates on Upper Palaeolithic culture in South Asia are excellent examples of how chronometric dating and high-resolution lithic studies are crucial in understanding Palaeolithic cultural developments. The Upper Palaeolithic culture was characterised by the blade and burin tools that succeeded the Middle Palaeolithic and preceded the Mesolithic culture or microlithic technology that appeared at the terminal Late Pleistocene in western Eurasia. The presence of distinct Upper Palaeolithic technology in South Asia is still contentious owing to the absence of chronometric ages and detailed lithic analyses.

J. A. Brown (1889) first described South Asian blade tool assemblages. Foote (1916) drew some broad cultural parallels and classified the Upper Palaeolithic assemblages of Billa Surgam caves as Magdalenian-like assemblages. Later, Cammiade & Burkitt (1930) conservatively attributed the blade tools occurring in Cammiade's collections made from Kurnool District, Andhra Pradesh, as Series III artefacts. Todd (1932) complimented Cammiade's work by reporting similar Series III lithic assemblages from the Khandivalli sector near Bombay. Based on the descriptions of blade and burin tools by (Cammiade & Burkitt 1930) (Todd, 1932) and Carlleyle in 1880-81 (Brown, 1889), D.H. Gordan (Gordon, 1950) argued for the presence of Upper Palaeolithic culture in South Asia. However, these discoveries were not convincing enough to confirm the presence of Upper Palaeolithic culture in South Asia due to technological similarities of the assemblages with the African parallels rather than the Eurasian (Kennedy, 2000). However, the later discoveries of several Upper Palaeolithic sites across the region suggested a pronounced similarity with the European assemblages and complimented the arguments of Foote (Murty, 1979). Systematic investigation of these blade-based assemblages from Patne, Maharashtra, provided an uncalibrated ^{14}C age of 25 ka stratigraphically preceded by unifacial dominant MP and succeeded by Blade and microblade assemblages (Sali, 1974). However, the distinctiveness of Upper Palaeolithic assemblage has been recently contested, as most of the above works of Palaeolithic archaeology in the Indian subcontinent are heavily influenced by European technological framework and nomenclature. Often, conventional European terms are misleading and fail to define the various aspects of Indian prehistoric records adequately.

Of late, these previously assumed Upper Palaeolithic assemblages have been redefined as Late Palaeolithic assemblages (dominated by microblade and bladelet components) (Blinkhorn, 2018; James & Petraglia, 2005). However, Late Palaeolithic emphasised the microblade/microlith industry of the Late Pleistocene. It hardly discusses the nature of macro-blade (larger than 4 cm) assemblages reported from sites like Kurnool and Site-55. Many of these previously assumed 'Upper Palaeolithic' tool components are prominently appearing in MP contexts; for example – blades, flake-blade, burins, end-scrapers, and micro blades found within MP layers at Bhimbetka (Misra, 1982). These blade components are often considered a continuation of Middle Palaeolithic technological practices in different parts of South Asia (Misra & Bellwood, 1985). Clarkson demonstrates the parallel occurrence of the Blade and microblade technologies in the younger Middle Palaeolithic sites. Levallois/Discoidal reduction methods in a Late Palaeolithic assemblage (JWP 9D) show the technological transition at the site. Clarkson argues that the backing of blade blanks and its miniaturisation appears to be a gradual progression where the size (length) of blades is diminishing moderately, showing gradual in-situ emergence of these (referring to Late Palaeolithic techno-complex) blade-based industries (Clarkson et al., 2012a). Similar evidence is also reported from Dhaba, Ayodhya hill sites, Fa-Hien Lena (Sri Lanka), and Mehtakheri showing the local or convergent emergence of the Late Palaeolithic. However, in the absence of human fossil records, it is hard to rule out the possibility of cultural displacement or diffusion due to new hominin populations' arrival during the Late Pleistocene.

1.5 Major Objectives of the Research

1. Undertake intensive surveys in the basin area to locate Palaeolithic sites and revisit previously explored sites.
2. Carry out test excavations, section scrapings and step trenching at potential Palaeolithic sites to recover sediment and lithic samples from secure contexts.
3. Reconstruct the chronological framework of the region using the Optically Stimulated Luminescence dating method to date sediments containing lithics and fossils.
4. Conduct sedimentological analysis such as particle size, Mineral magnetics, and Loss on Ignition to understand the site formation process.
5. Analyse the lithic assemblages typologically and technologically by recording several attributes. These attributes will be used to understand the reduction strategies, including raw material preferences, patterns in biface production, core preparation, flake production and tool production.
6. Examine the spatial and temporal variation in prehistoric material culture at the Gundlakamma basin. The investigations focussed on questions concerning the manufacture and transportation of chipped stone artefacts, the economics of procurement and the mechanisms which produced assemblage variation. The objective is to describe the chipped stone technology of prehistoric occupants and determine their response to environmental changes as reflected in the material culture.
7. Reconstruct the study area's prehistory and use the research results to address general issues of prehistoric technology, settlement pattern, hominin adaptations, and dispersals.

1.6 Organisation of the Thesis

Chapter 1 presents how the current research draws inspiration from existing scholarship in prehistoric archaeology and other associated disciplines. It also discusses why the topic is essential to the discipline, the gap in knowledge and the need to generate more systematic data. The chapter reviews previous work on this topic by citing relevant literature and includes an overview of the objectives of the present work.

Chapter 2 introduces the physiographic setting of the region, followed by the cultural framework of the region. The chapter's objective is to place the prehistoric evidence in the geological and geomorphological background of the region to understand the site distribution and settlement patterns.

Chapter 3 discusses the methods employed in the data collection and their limitations. The chapter elaborates on the survey strategies, such as reading the topographic sheets and satellite images, Optically Stimulated Luminescence dating techniques to date the sediments, and the methods used for lithic artefact and faunal analysis. It further includes the data classification and multiple methods used to analyse recovered data.

Chapter 4 presents the significant results of the current research. The chapter presents the results of the field surveys undertaken and the distribution of sites in the background of the region's physiography. Among the reported sites, a few selected sites were investigated in greater detail, and this chapter discusses these sites by presenting their geological context, sedimentology, OSL ages and nature of lithic assemblages.

Chapter 5 discusses the interpretation of the data presented in the previous chapter to fulfil the aims and objectives of the current research. Further, the chapter presents how the current research results are used to shed significant insights on various issues, such as the Youngest Toba Tuff beds in South Asia as a Late Pleistocene chronological marker. Nature of Lithic Assemblages before and after the Toba super-eruption of 74 ka, Late Acheulian to Middle Palaeolithic transitions in South Asia, Post-Middle Palaeolithic cultural developments in South Asia, Initial Modern Human Colonization of South Asia, and Archaic Hominin - Modern Human interactions in South Asia. The chapter aims to address the abovementioned issues through the data collected through multidisciplinary approaches.

The concluding **Chapter 6** of the thesis summarises the crucial aspects of the current research in appreciating hominin migrations and their adaptations in South Asia. It further emphasises the significance and limitations of the current research and the future scope of prehistoric archaeology.